Reference: *Biol. Bull.*, 137: 332–337. (October, 1969)

# *RYNKATORPA PAWSONI* N. SP. (ECHINODERMATA: HOLOTHUROIDEA) A COMMENSAL SEA CUCUMBER [1]

W. E. MARTIN

*Department of Biological Sciences, University of Southern California, Los Angeles, California 90007*

An angler fish, *Gigantactis macronema* Regan, was collected September 12, 1968 by the VALERO, scientific vessel of the University of Southern California, in a net haul between 500 and 1050 fathoms, 19.5 miles southeast of Head Light on San Clemente Island off the coast of Southern California. Four small, gray, nearly cylindrical organisms were attached to one side of the fish grouped near one another. At first it was thought that these might be helminths, but study of three mounted whole and one serially sectioned revealed that they were sea cucumbers. The whole mounts were stained with Mayer's paracarmine and the serial sections with Mallory's triple. This apparently is a new ecological association for echinoderms. A note has been published on this association (Martin, 1969). This species is named in honor of Dr. Pawson, Smithsonian Institution, in recognition of his many contributions to the knowledge of holothurians.

## DESCRIPTION

Order Apodida Brandt, 1835
Family Synaptidae Burmeister, 1837
*Rynkatorpa* Rowe and Pawson, 1967
*Rynkatorpa pawsoni* n. sp.

Body subcylindrical, gray (when fixed in alcohol), 5.18 to 7.14 mm long and 1.75 to 2.52 mm in maximum width. Body surface irregular with small lobes and indentations. Raised clusters of nuclei in circles or ridges scattered over body surface. Tube feet, anchors, plates, and respiratory tree lacking. Twelve digitiform, muscular, retractable tentacles, each with 2 digits. Pharynx with twelve ridges projecting into its lumen. Digestive tract tubular, looped, with anus at posterior end of body. Intestinal lining smooth in some areas and multi-ridged in others. Five longitudinal muscle bands containing thick and thin fiber bundles are interconnected by circular muscle fibers. Ring canal near bases of tentacles with one polian vesicle and one stone canal, approximately opposite one another. Nerve ring near bases of tentacles with a nerve to each tentacle and to each longitudinal muscle band. Small lobed mass of cells seen in one specimen in anterior third of body of unknown function. One specimen has a branched structure in the posterior part of the body that might be a gonad.

Attached by posterior end to the fish host: *Gigantactis macronema* Regan. Locality: Near coast of Southern California Holotype E11154; paratype E11155 U. S. Nat'l. Mus.

[1] Supported by N. S. F. GB 6962.

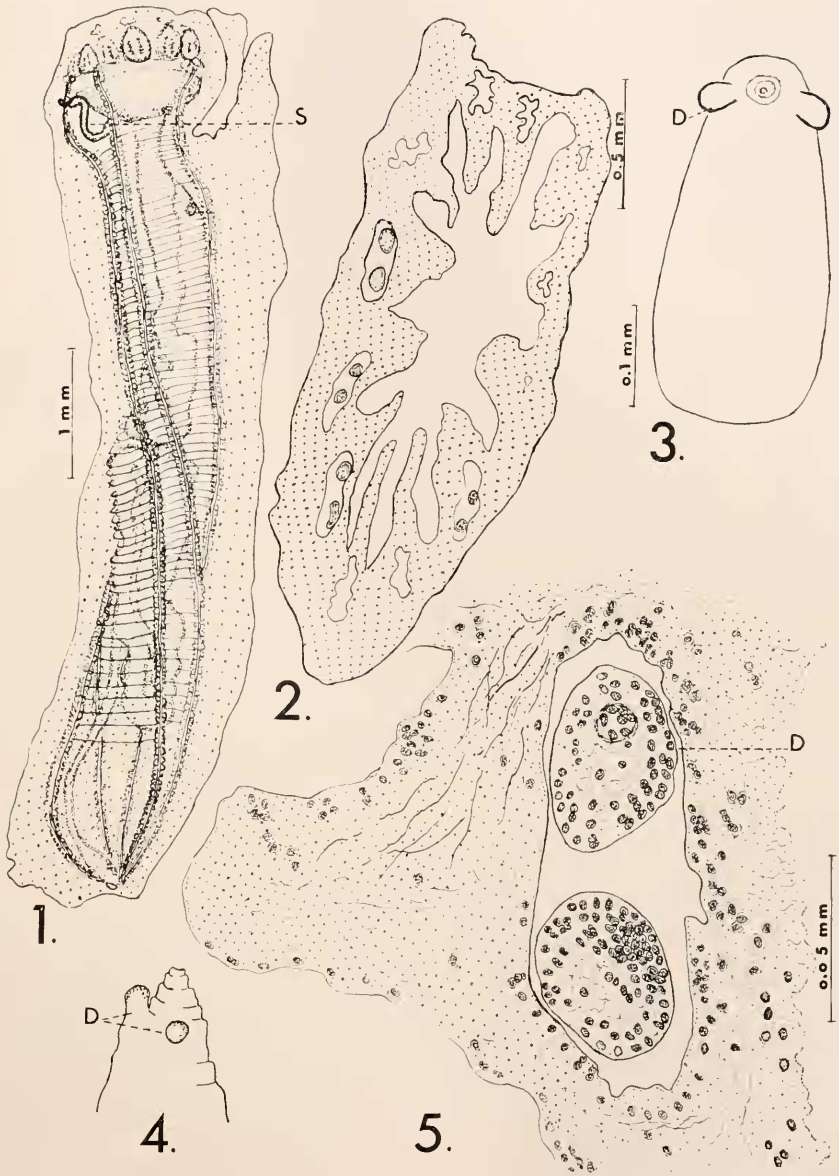


FIGURE 1. Lateral view of entire specimen, stone canal (S). All figures drawn with the aid of a camera lucida unless otherwise indicated.

FIGURE 2. Section through body near anterior end. Cross sections of some digits are evident in tentacular sacs. Twelve ridges project into digestive tract.

FIGURE 3. Diagram of an extended tentacle with digits (D).

FIGURE 4. Lateral view of partly extended distal part of tentacle bearing two digits (D).

FIGURE 5. Area surrounding a tentacle sac containing two digits (D).

Further descriptive details are as follows. The body surface is very irregular with identations, folds and protrusions of various shapes. Some of the thinner folds are composed of only two layers of epidermis while most contain an additional fibrous layer. The thin cytoplasmic epidermis contains numerous nuclei, usually in single file. Cell walls were not observed even under the oil immersion lens and therefore the epidermis is believed to be syncytial. However, electronmicrographs might reveal cell walls. Except for the clumping of nuclei in scattered knobs, ridges and crescents, there is no apparent specialization of the epidermis in different regions of the body. The thickness of the epidermis usually varies from 3 $\mu$ to 9 $\mu$ except at the knobs or other raised areas where it may reach 30 $\mu$.

The fibrous layer or dermis, underlying the epidermis, forms the bulk of the body wall. The fibers, presumably collagenic, form a dense network ramifying in all directions. Here and there are knot-like masses where fibers converge. Some fibers are only 0.3 $\mu$ but others are 3.0 $\mu$ in thickness. The fibrous layer varies in thickness from 20 $\mu$ to 32 $\mu$. Scattered in the fibrous layer are cells, probably fibrocytes.

Some of the five longitudinal muscle bands decrease in size at certain levels of the body but are well developed anterior and posterior to these levels.

The coelomic lining is a delicate layer only 1.6 $\mu$ thick where it thins out between nuclei but it is 6 $\mu$ at nuclear locations. This layer forms thin mesenteries from 3 $\mu$ to 6 $\mu$ thick. In the anterior and posterior parts of the body, the mesenteries include a few muscle fibers. Mesenteries are more numerous in the anterior body region. The mesenteries attach to ridged modifications of the wall of the digestive tract. Most such ridges are nearly circular in cross section with attenuated bases where they join the digestive tract. They include an extension of connective tissue fibers from the wall of the digestive tract.

The branched structure seen in the posterior part of the body of one specimen and suggested as a possible gonad is in an unusual position because holothurians generally have gonads in the anterior part of the body.

The stone canal wall is packed with nuclei and has a sparse supply of connective tissue fibers. It is about 16 $\mu$ thick. The outside dimensions of a cross section of the stone canal are approximately 44 $\mu$ by 68 $\mu$. The lumen of the canal is about 6 $\mu$ in diameter.

The mouth is irregular in outline with twelve longitudinal ridges, corresponding in position to the tentacles, that project into the lumen. It leads into the pharynx which has a relatively thick wall that contains some muscle and connective tissue fibers. The most elaborate infoldings of the digestive tract lining occur in the pharynx. These may have central columns reinforced by fibers and support as many as six folds on each side. The esophagus is thin-walled and also has folds extending into its lumen except where it is expanded and the lining is smooth. The stomach has the thickest wall and it appears to be mainly glandular with very poor representation of muscle and connective tissue fibers. It is richly supplied with nuclei some of which are twice as large as others. The lining of the stomach is smooth where this organ is expanded but is longitudinally ridged in other areas. The intestine is nearly circular in cross section and it contains numerous projections into the lumen. The posterior part of the intestine has

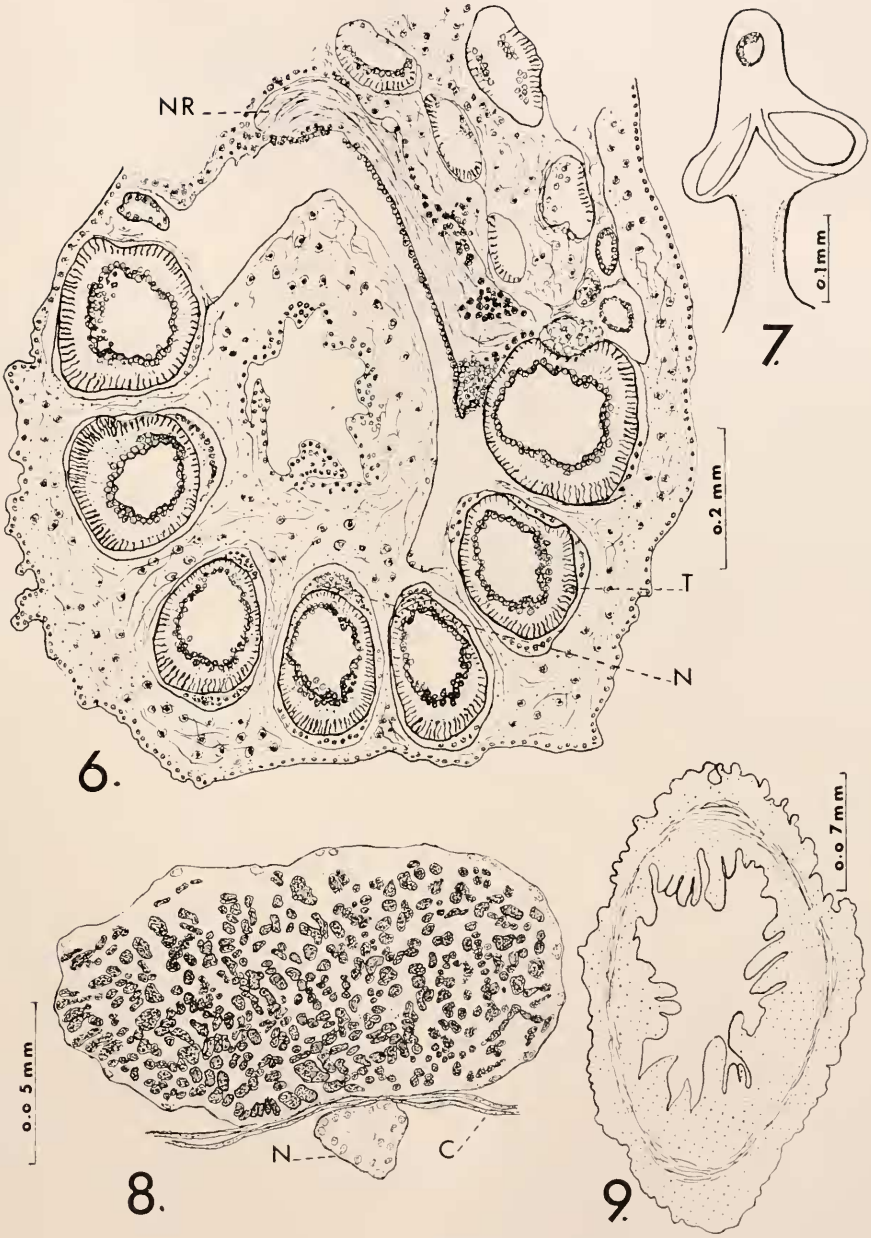


FIGURE 6. Section through tentacle region showing cross sections of tentacles (T) with muscle fibers; nerve (N) supplying tentacle and nerve ring (NR).

FIGURE 7. Lateral view of polian vesicle.

FIGURE 8. Cross section of longitudinal muscle band, associated circular muscle fibers (C) and nerve (N).

FIGURE 9. Cross section of digestive tract showing ridged lining.

more muscle fibers than any other part of the digestive tract. Here, approximately one-half the thickness of the wall is composed of muscle fibers.

The nerve ring and longitudinal nerve cords have the neuronal nuclei located mainly on or near the surface where they form almost a continuous layer.

The walls of the tentacles are richly supplied with muscle fibers especially on the side nearer to the body surface. There is a thin fiber layer immediately peripheral to the muscle layer. The tentacles and digits contain lumina.

## Discussion

The lack of anchors and plates in this species may be natural or may be due to treating the specimens with weak HCl in the destaining process. Their absence makes it difficult to decide if the species should be placed in the genus *Protankyra* Östergren, 1898, *Rynkatorpa* Rowe and Pawson, 1967, or in a new genus. Rowe and Pawson (1967) transferred several species from *Protankyra* to *Rynkatorpa* mainly on differences in anchors and plates. Two of those transferred, *R. duodactyla* (H. L. Clark, 1907) and *R. bicornis* (Sluiter, 1901), are like *R. pawsoni* in having two digits on each of the twelve tentacles. However, *R. bicornis* has four or five stone canals and *R. duodactyla* has two polian vesicles. Both *R. bicornis* and *R. duodactyla* are bottom-dwelling species. Because of the similarities of twelve tentacles, each with two digits, the species *pawsoni* is provisionally placed in the genus *Rynkatorpa*.

In the cross section of a longitudinal muscle band (Fig. 8) there appear to be fibers of different diameters. However, the larger units are either clusters or oblique or transverse fibers as has been reported for *Stichopus mollis* by Freeman and Simon (1964). Baccetti and Rosati (1968) examined the ultrastructure of muscles in *Holothuria tubulosa* and suggested that they contain paramyosin, the first reported occurrence in the phylum Echinodermata of the "catch" type of muscle. Paramyosin has been found in lamellibranchs, gastropods, annelids, and possibly arthropods.

Although *R. pawsoni* is firmly attached to the bathypelagic host's rough skin and small dermal denticles, there seems to be little or no invasion of host tissues. Hence, the association is believed to be commensal with the cucumber benefitting by being taxied about with no effect upon the host. How the cucumber contacts the fish host remains unknown. Some cucumbers can swim (Hansen and Madsen, 1956) and perhaps *R. pawsoni* can.

The *Gigantactis macronema* from which the cucumbers were removed is one of the largest (about 325 mm, standard length) ever captured. Bertelsen (1951) mentions that the type specimen of *G. macronema* is 133 mm long. The illicium (slender lure) of the present specimen is over three and one-half times the body length. Bertelsen also stated that these fish are quite widely distributed and that they generally are captured at depths between 500 and 2000 meters.

I wish to acknowledge the help of my assistant, Mr. Kevin Springer, for making the serial sections; Dr. Russel Zimmer for suggesting that the specimens might be holothurians; and Dr. David L. Pawson for critically reading the manuscript.

## Summary

A new species of sea cucumber is described from the Pacific Ocean off Southern California. It is provisionally assigned to the genus *Rynkatorpa* as *R. pawsoni*. Four specimens were found attached to the side of a bathypelagic fish, *Gigantactis macronema* Regan. There was no apparent invasion of host tissue so the association is believed to be commensalism. This is the first description of a commensal echinoderm.

## LITERATURE CITED

Baccetti, B., and F. Rosati, 1968. On the thick filaments of holothurian muscles. *J. Microsc.*, **7**: 455–458.

Bertelsen, E., 1951. The ceratoid fishes. *Dana Rep. Carlsberg Found.*, **39**: 1–276.

Clark, H. L., 1907. The apodous holothurians: A monograph of the Synaptidae and Molpadiidae. *Smithsonian Contributions to Knowledge* (No. 1723), **35**: 1–231.

Freeman, W. P., and S. E. Simon, 1964. The histology of holothuroidean muscle. *J. Cell. Comp. Physiol.*, **63**: 25–38.

Hansen, B., and F. J. Madsen, 1956. On two bathypelagic holothurians from the South China Sea *Galathcathuria* n.g. *aspera* (Théel) and *Enypniastes globosa* n. sp. *Galathea Report*, **2**: 55–59.

Martin, W. E., 1969. A commensal sea cucumber. *Science*, **164**: 855.

Rowe, F. W. E., and D. L. Pawson, 1967. A new genus in the holothurian family Synaptidae, with a new species from Tasmania. *Proc. Roy. Soc. Tasmania*, **101**: 31–35.

Sluiter, C. P., 1904. Die Holothurien der Siboga-Expedition. *Siboga-Expedition Monogr.*, **44**: 1–141.